

Submitted to:

U.S. Fish and Wildlife Service
Edwin B. Forsythe National Wildlife Refuge
800 Great Creek Road
Galloway, NJ 08205

**Shortwave Radio Development and History at Ocean Gate/Good Luck Point and
Manahawkin, Ocean County, New Jersey**

FINAL

Lead Agency: U.S. Fish and Wildlife Service



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A handwritten signature in blue ink, appearing to read "Matthew E. Prybylski", written over a horizontal line.

Signature

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Project Principal Investigator

6 April 2017

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1.0 INTRODUCTION

1.1 The Project

The Edwin B. Forsythe National Wildlife Refuge in Ocean County, New Jersey contains two former AT&T facilities instrumental in the early development and use of shortwave transmissions to communicate with ships at sea and over long distances. These two historic properties, namely the AT&T Transmitter Building and Antenna Field located in the Ocean Gate/Good Luck Point, and the AT&T Manahawkin Receiver Building and Antenna Field located in Manahawkin, were found eligible for listing in the National Register of Historic Places. These facilities contain buildings housing the transmission and receiving equipment but also have hundreds of abandoned poles, metal antennas and associated support structures like guy wires. The U.S. Fish and Wildlife Service needs to remove a number of poles and antennas in order to enhance, conserve, and protect fish, migratory birds and wildlife in the Refuge. The AT&T Marsh Restoration and Pole Removal Project needs to adhere to regulations regarding the protection of the natural and cultural environment (36 CFR Part 800, regulations implementing Section 106 of the National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470f) and the U.S. Fish and Wildlife Service (Service) is required to take into account the effects of federal undertakings, like the pole removal, on properties listed on, or eligible for the National Register of Historic Places (NRHP).

A proposed Pole Removal Plan was prepared by Amec Foster Wheeler Environment & Infrastructure (Amec Foster Wheeler) to document the removal of wooden poles, metal antennas, and associated support structures (guy wires, above ground pieces of foundation, and other debris) from these two areas that are managed by the U.S. Fish & Wildlife Service (Service) within the Refuge. The poles were erected between 1929 and 1938 for the purpose of providing telephone communications to ships at sea and to overseas locations. These historic properties provided an interface between shortwave reception and America's telephone network as well as ship-to-shore transmissions beginning in 1930 and continued to 1999. Following the devastating effects of Hurricane Sandy, the U.S. Fish and Wildlife Service decided to remove the majority of the antenna pole structures and restore the marshes to more natural conditions. A number of poles will be incorporated into the marsh rehabilitation as osprey nesting locations.

As part of the project, a total of 131 poles were identified for removal at the Manahawkin Project area and 493 poles were identified for removal at the Ocean Gate/Good Luck Point Project area. The poles will be cut as close to the ground as possible and transported to central staging areas at each location and disposed. Cables and other metal debris will be collected and recycled. Additionally, a limited number of metal antennae at each location will be dismantled and removed, and metal debris recycled.

In a Memorandum of Agreement (MOA) between AT&T, U.S. Fish and Wildlife Service, and the New Jersey State Historic Preservation Office, mitigation efforts included four steps: 1) Documenting the antenna fields using Historic American Engineering Record (HAER) Level II Documentation, 2) Pole Data Recordation, 3) a definitive Historic Property Context Documentation using archival records and 4) a Popular Report for public distribution and education.

Amec Foster Wheeler conducted additional archival/documentary research on the two historic properties in order to prepare a comprehensive documentation report recording the history of each property. Archives at Warren, New Jersey where AT&T stores records as well as historic newspapers, journals, and on line archive sources were accessed to help tell the history of the

Ocean Gate/Good Luck Point shortwave radio transmission station and the Manahawkin receiving station.

1.2 The Project Areas

The Manahawkin Project area is identified by Stafford Township as a portion of Block 296 at the end of Beach Avenue (**Figure 1**). Approximately 390 acres in size, the Project area is generally situated between Marshelder Pond to the east, Standing Pond and Log Creek Pond to the south, additional marshland to the north, and Cedar Creek to the west (**Figures 1-5 and 6**).

The second Project, Ocean Gate/Good Luck Point, is located within Berkeley Township in Block 1207 along Bayview Avenue (**Figure 7**). The Ocean Gate/Good Luck Point Project area is approximately 222 acres, situated between Barnegat Bay, E. Atlantic Avenue, Toms River to the north, and residential properties to the west (**Figures 8, 9 and 10**).

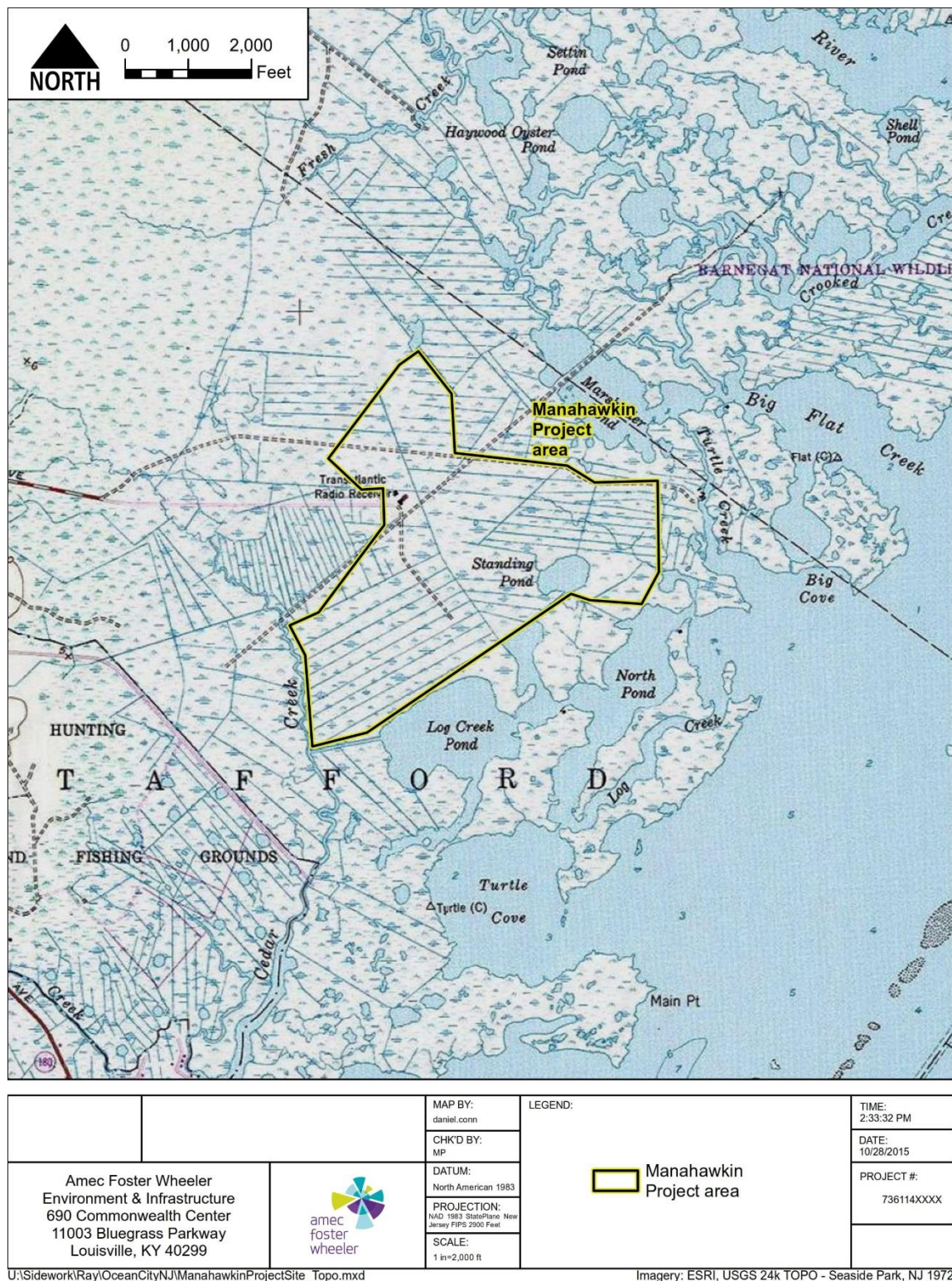
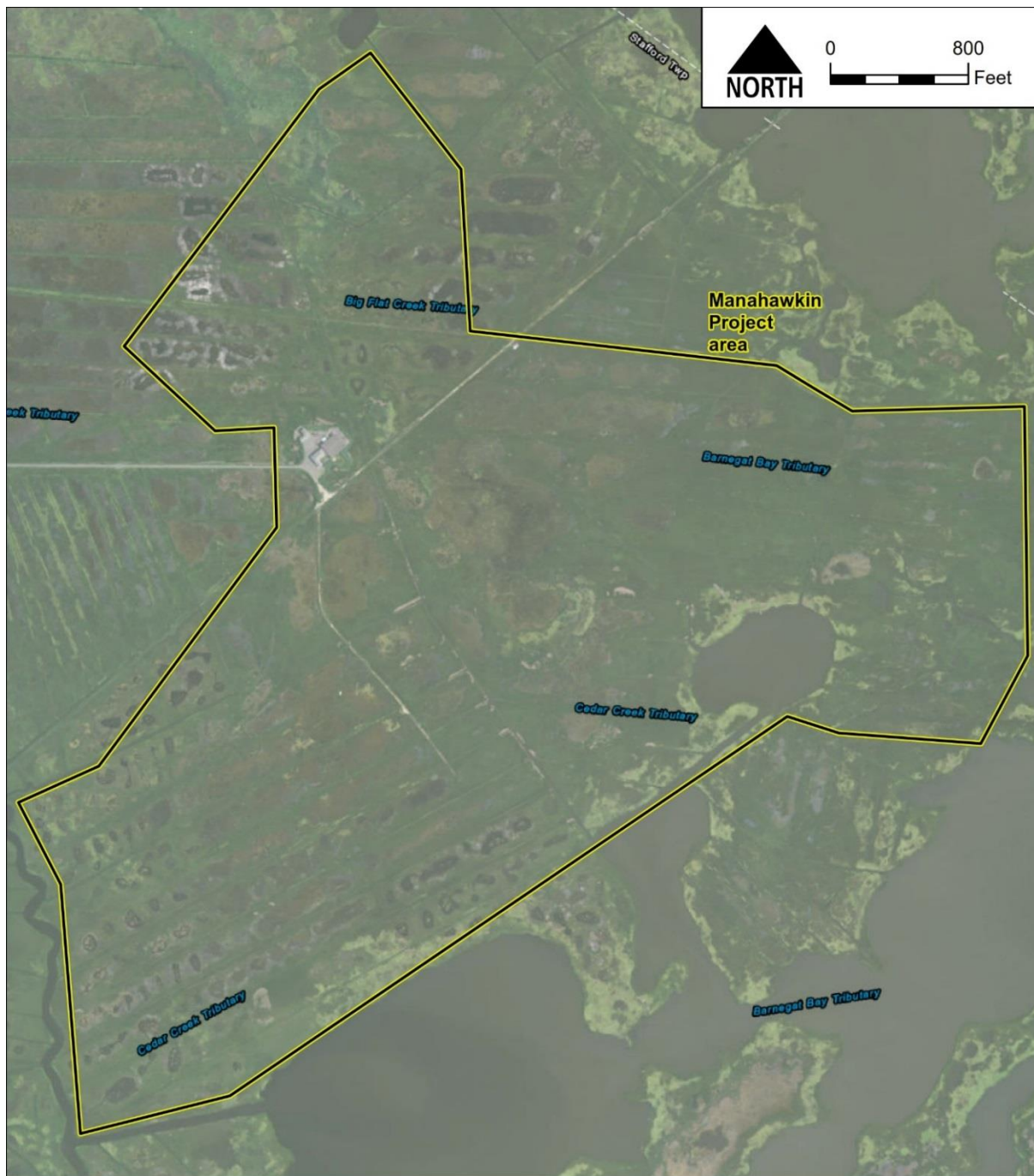



Figure 1. USGS Topo of the Manahawkin Project area.



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| <p>Amec Foster Wheeler Environment & Infrastructure 690 Commonwealth Center 11003 Bluegrass Parkway Louisville, KY 40299</p> | | MAP BY: daniel.conn | <p>LEGEND:</p> <p> Manahawkin Project area</p> | TIME: 2:34:49 PM |
| | | CHK'D BY: MP | | DATE: 10/28/2015 |
| | | DATUM: North American 1983 | | PROJECT #: 736114XXXX |
| | | PROJECTION: NAD 1983 StatePlane New Jersey FIPS 2600 Feet | | |
|  | | SCALE: 1 in=800 ft | | |
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Imagery: ESRI, NAIP 7/18/2013

Figure 2. Aerial Image of the Manahawkin Project area.



Figure 3. Photo of the Manahawkin Receiver Station (Pasquariello and Breetzke 2015).



Figure 4. Photo of the Manahawkin Receiver Station (Pasquariello and Breetzke 2015).




Figure 5. Photo of a Manahawkin Curtain Antenna (Pasquariello and Breetzke 2015).



Figure 6. Photo of a Manahawkin Rhombic Antenna (Pasquariello and Breetzke 2015).



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| | | MAP BY: daniel.com | LEGEND: <div><div></div>Ocean Gate/Good Luck Point Project area</div> | TIME: 2:17:44 PM |
| | | CHK'D BY: MP | | DATE: 10/28/2015 |
| Amec Foster Wheeler Environment & Infrastructure 690 Commonwealth Center 11003 Bluegrass Parkway Louisville, KY 40299 |  | DATUM: North American 1983 | | PROJECT #: 736114XXXX |
| | | PROJECTION: NAD 1983 StatePlane New Jersey FIPS 2900 Feet | | |
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Imagery: ESRI, USGS 24k TOPO - Seaside Park, NJ 197

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Imagery: ESRI, USGS 24k TOPO - Seaside Park, NJ 1972

Figure 7. USGS Topo of the Ocean Gate/Good Luck Point Project area.



Figure 8. Aerial Image of the Ocean Gate/Good Luck Point Project area.



Figure 9. Photo of the Ocean Gate/Good Luck Point Transmitter Station (Pasquariello and Breetzke 2015).



Figure 10. Photo of the Ocean Gate/Good Luck Point Antenna Field (Pasquariello and Breetzke 2015).

2.0 ANTENNA POLE STRUCTURES STATISTICAL ANALYSIS

In the summer and fall of 2016, Amec Foster Wheeler began mitigation efforts to document the pole and antenna removal and the history of two pre-World War II communication facilities in Ocean County, New Jersey; the AT&T Transmitter Building and Antenna Field located in the Ocean Gate/Good Luck Point, and the AT&T Manahawkin Receiver Building and Antenna Field located near Manahawkin listed on the NRHP. A total of 624 antenna pole structures at the two facilities were documented as part of the mitigation efforts (**Figures 11 and 12**). The types and array of antenna pole structures varied considerably across the sites. The styles and forms encompassed single poles, A-framed, H-framed, Lattice, as well as multi-poled structures with irregular forms. While the majority of the poles were constructed of wood, similar to common utility poles, a number of metal structures were also recorded.

Given the degenerative nature of marshes, the age of the poles, as well as meteorological conditions common to the coast of New Jersey. The physical condition of each pole was important to assess and record as it would have a direct effect on the removal process. Often times, how intact the pole was directly related to the amount of degradation or deterioration of a particular pole, and vice versa. How intact each pole was broken down in to “complete” for full-standing poles, “collapsed” for poles that had been felled by storms, “truncated” for those poles that were deliberately cut with only a stump remaining, and “incomplete” for where the majority of the pole was completely removed by a storm, but a small jagged stump remained. The overall state of degradation was recorded as either “good” for poles that appeared to have little to no weathering and/or damage, “fair” for those poles that contains some cracking and general weathering, or “poor” for those poles that had extensive amounts of deterioration and/or were no longer whole.

A variety of other data was also recorded during the fieldwork for the antenna pole structures and included over-all height, circumference, style/form, number of associated poles (single or multi-poled configurations), number of guy-wires, and the presents of hardware. It should be noted that complete data descriptions and photos of the individual poles can be found in the Pole Data Recordation Documents on file at the U.S. Fish and Wildlife Service office in Galloway, New Jersey.

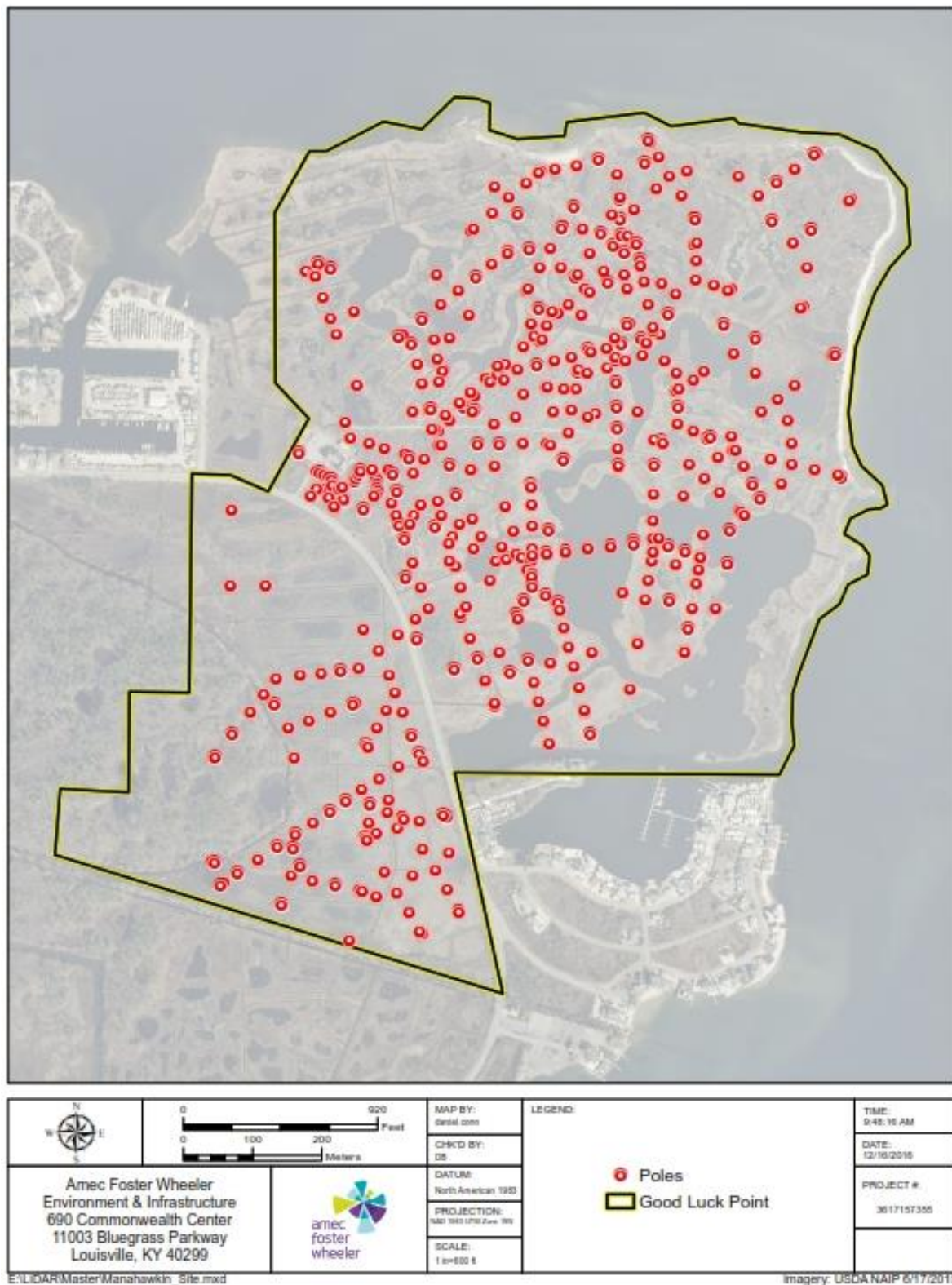


Figure 11. Location of antenna pole structures at Ocean Gate/Good Luck Point Antenna Field.

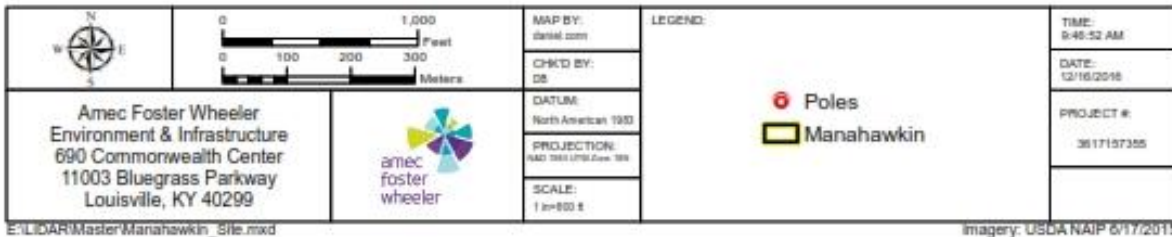
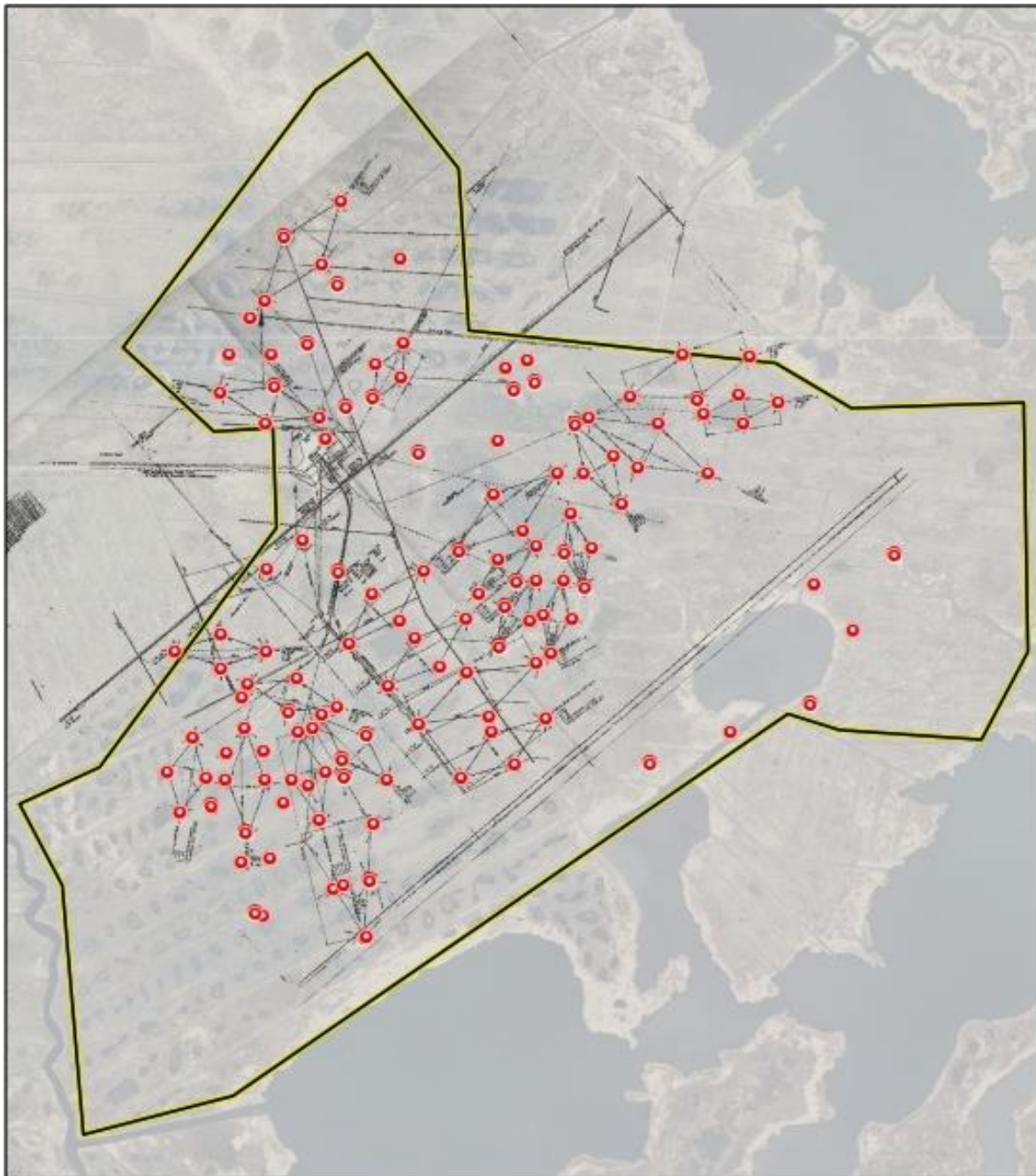


Figure 12. Location of antenna pole structures at Manahawkin Antenna Field.

3.0 HISTORY OF SHORTWAVE RADIOTELEPHONE

3.1 Manahawkin Shortwave Receiving Station

By the late 1920s, studies had indicated that improvements were needed to further radiotelephone communications from ship-to-shore that could handle the increased communication traffic. A new antenna system (MUSA – Multiple Unit Steerable Antenna) had been developed by Bell Telephone Laboratories that would allow clearer radio circuits and increase the available channels through the use of rhombic or diamond-shaped antenna array that could target shortwave radio signals. MUSA was especially important because now it was possible to monitor the incoming radio waves, provide a selective system for their reception, and furnish the means for combining the waves into a single telephone circuit. For radiotelephone communications, this was extremely important and greatly improved communications over long distances. To do this it was necessary to use a number of rhombic antennas, in fact, the more antennas used the better the results or the sharper the "steering" (Hoyt 1939:4 and 5; Fink and Bennett 1930).

This new MUSA communication system required a new and improved antenna array. The length of the new antenna system, along with other technical requirements made it necessary to find a new location for this new system and by the end of 1937 a site was chosen on a tract of land comprising 2,400 acres in Stafford Township, Ocean County, New Jersey near Barnegat Bay known as the Manahawkin Great Meadows (Borthwick 1939). The new station would be near the village of Manahawkin and about 85 miles south of New York and 75 miles east of Philadelphia.

The marshy conditions of the new facility location called for specific wetland construction techniques. The access road to the building that was to house the radio receiving equipment was actually built to float on the marshy surface by using a series of pine planks. This type of road, called a corduroy road was laid down using layers of salt hay, sod, gravel and fill to build the road above the marsh and stability the planks (see **Figures 13 and 14**).



Figure 13. Use of a special sod cutter during construction of the corduroy road into the Manahawkin facility (taken from Fink and Bennett 1939).

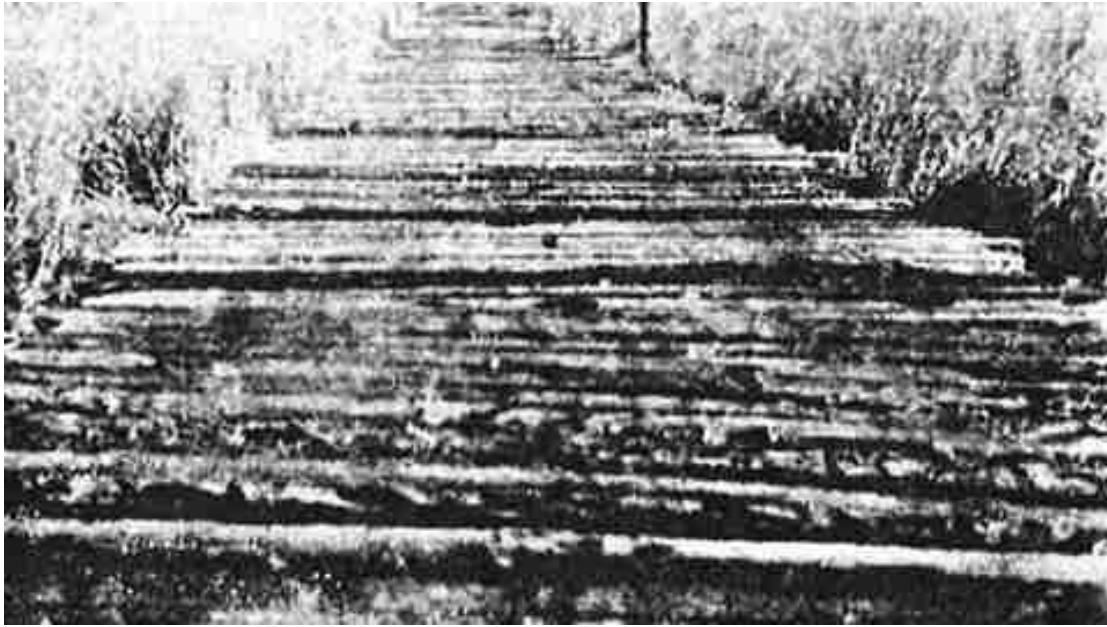


Figure 14. Corduroy access road composed of pine planks at the Manahawkin facility (taken from Fink and Bennett 1939).

The sandy soil type and wet conditions necessitated that the station building foundation rest on wooden piles driven into the ground. Twenty-foot piles were used under the station building and capped with concrete. For a structure measuring 43 feet by 75 feet with an addition measuring 23 feet by 34 feet used as a garage; 85 piles were used for the foundation (Fink and Bennett 1939) (**Figure 15 and 16**). The floor was tied to the concrete caps using a grid system of reinforced concrete beams that rested on the caps. As the brick station would be in an open marsh area subject to wind and rain damage; the walls were painted with waterproofed cement, heavy iron gutters used to direct water away from the building, and a copper roof added (Fink and Bennett 1939).

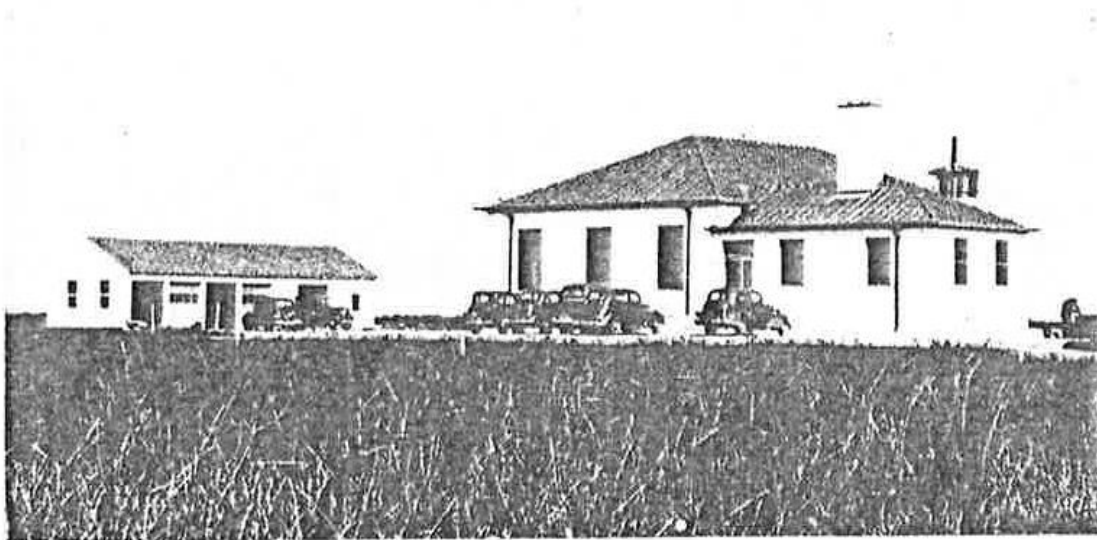


Figure 15. The building at Manahawkin, New Jersey when completed in 1939 (taken from Fink and Bennett 1939).



Figure 16. Manahawkin receiving station
(<http://www.coldwarcomms.org/miscellaneous/Manahawkin/Manahawkin.html> accessed November 2, 2016).

Once the short wave radio telephone receiving station had been built at Manahawkin, construction activities on the antenna system began. Work on the antenna array began in 1938 with the erection of 68 poles with guys and anchors, placing the transmission line and positioning the antenna wire to ready the system for preliminary testing (Bennett and Moroze) 1939). The 16 rhombic antennas composed of 64 poles were placed end to end over about two miles (**Figure 17**). Each antenna consisted of four 75 to 85 foot poles set in a diamond pattern about 600 feet long (Bennett and Moroze 1939). Individual antennas were about 60 feet apart with the antenna wire 65 feet above the ground surface (Bennett and Moroze 1939) (**Figures 18 and 19**).

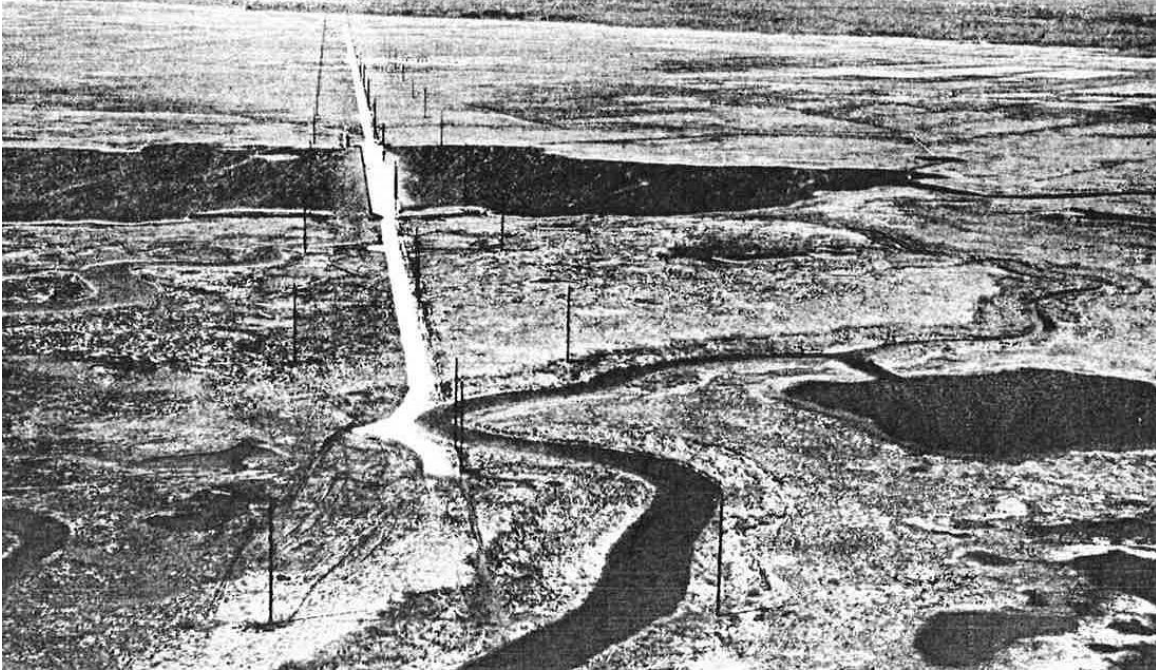


Figure 17. An airplane view of the tract at Manahawkin showing the antenna system, the service road and the receiving station (taken from Bennett and Moroze 1939).

From each of the individual antenna, coaxial cable was used to connect the transmission line to the receiving equipment in the building. In order to ensure proper transmission the inner and outer conductors were segregated using insulators spaced at specific distances. Some 36,000 insulators were used on 47,000 feet of line at the Manahawkin facility. A machine was developed to speed the placement of the insulators by a rigger foreman working at the Lawrenceville, New Jersey radio station. Use of the machine allowed the placement of 2,400 feet of line with insulators per day (Bennett and Moroze 1939). The line was spliced and lowered in to a trench about thirty inches deep between the various antennas and the building. Heavy layers of coal tar were applied to the copper pipe for protection and to ensure a water- and gas-tight line. A special solder composed of tin and antimony was used that completely filled and sealed any joint (Bennett and Moroze 1939).

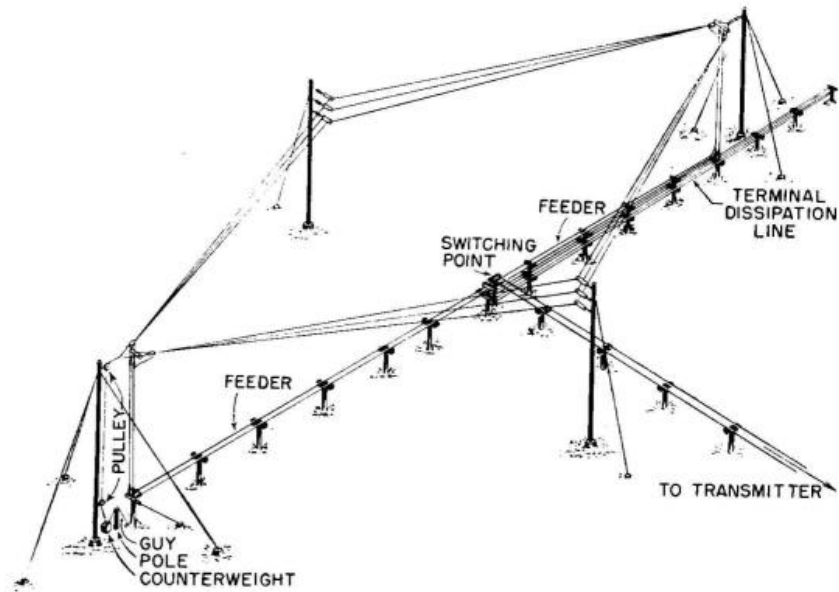


Figure 18. Horizontal rhombic antenna diagram (example taken from http://www.vias.org/radioanteng/radio_antenna_engineering_03_23_01.html website accessed December 3, 2016)

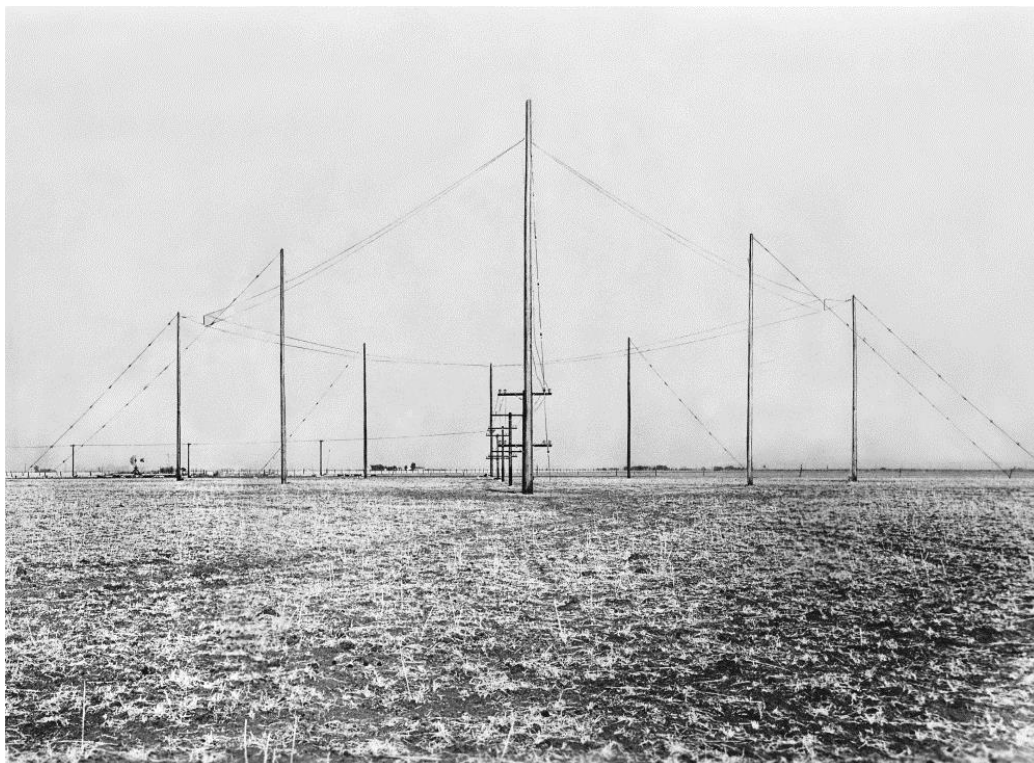


Figure 19. AT&T wire rhombic antenna used in Dixon, California. One of three facilities used for telephone service similar to Manahawkin and Ocean Gate/Good Luck Point (<http://www.theradiohistorian.org/Dixon/Dixon1.html> website accessed December 3, 2016).

The shortwave receiving station at Manahawkin employed the Multiple Unit Steerable Antenna or MUSA. The MUSA made for clearer radio circuits and allowed more channel availability. Since short waves bounce between the earth and the ionosphere, signals can arrive at the receiving station from multiple elevation angles (**Figure 20**).

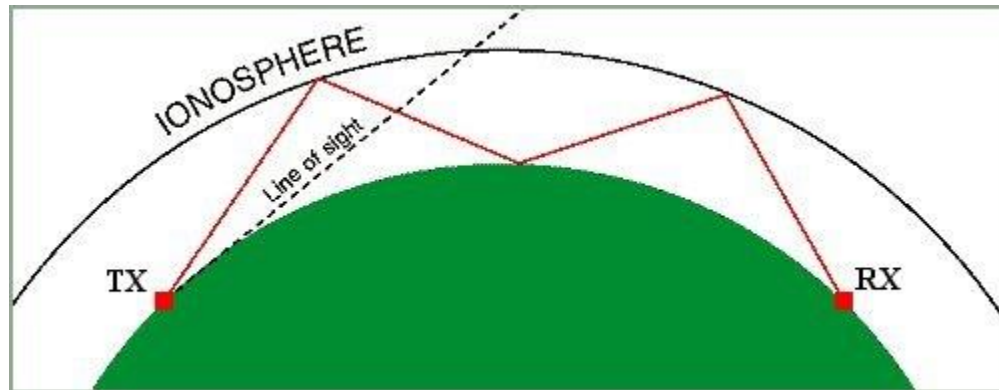


Figure 20. Bouncing shortwave signals from a transmitter to a receiver using the ionosphere (<http://www.viewzone.com/> website accessed December 4, 2016).

For the first time it was possible at the receiver to select from groups of incoming waves, to permit constant monitoring of the incoming waves, and furnish the means for combining a number of waves into a single telephone circuit (Hoyt 1939). The overall effect of MUSA equipment on radiotelephone receiving is an overall increase in volume and intensity with a decrease in noise distortion. At Manahawkin, the first MUSA employed 16 rhombic antennas in an array stretching two miles in a straight line pointing toward Europe somewhat similar to the MUSA developed at Holmdel, New Jersey (Hoyt 1939) (**Figure 21**). A later site layout plan of the Manahawkin rhombic array shows an expanded antenna field with variable pattern where different angles were used to receive waves from various angles and subsequent origination points around the world (**Figure 22**).

Since the station was originally constructed, additional antennas were added to the array. The addition of the antenna resulted in an even higher number of transmissions from both ship-to-shore and land transmissions all over the world. In fact, the stations in New Jersey were critical in communications to Europe. During World War II, the station at Ocean Gate/Good Luck Point was under armed guard. Messages that were transmitted from the Ocean Gate/Good Luck Point station were critical to the war effort (*Ocean County News Journal* 1976).

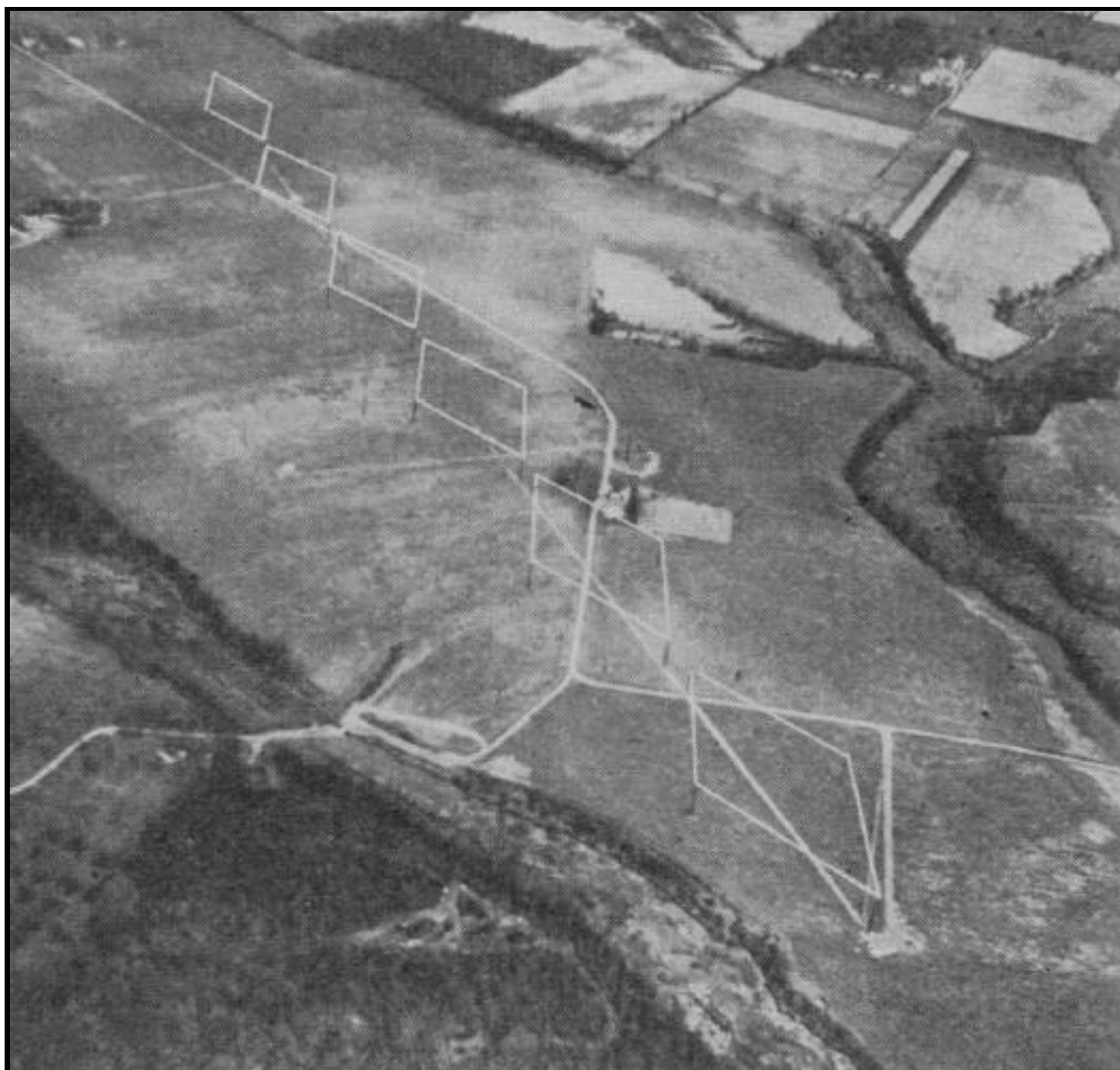


Figure 21. Aerial view of the experimental MUSA in Holmdel, New Jersey that the Manahawkin array was patterned after. The Manahawkin receiving station employed 16 rhombic antenna (taken from Friis and Feldman 1937).

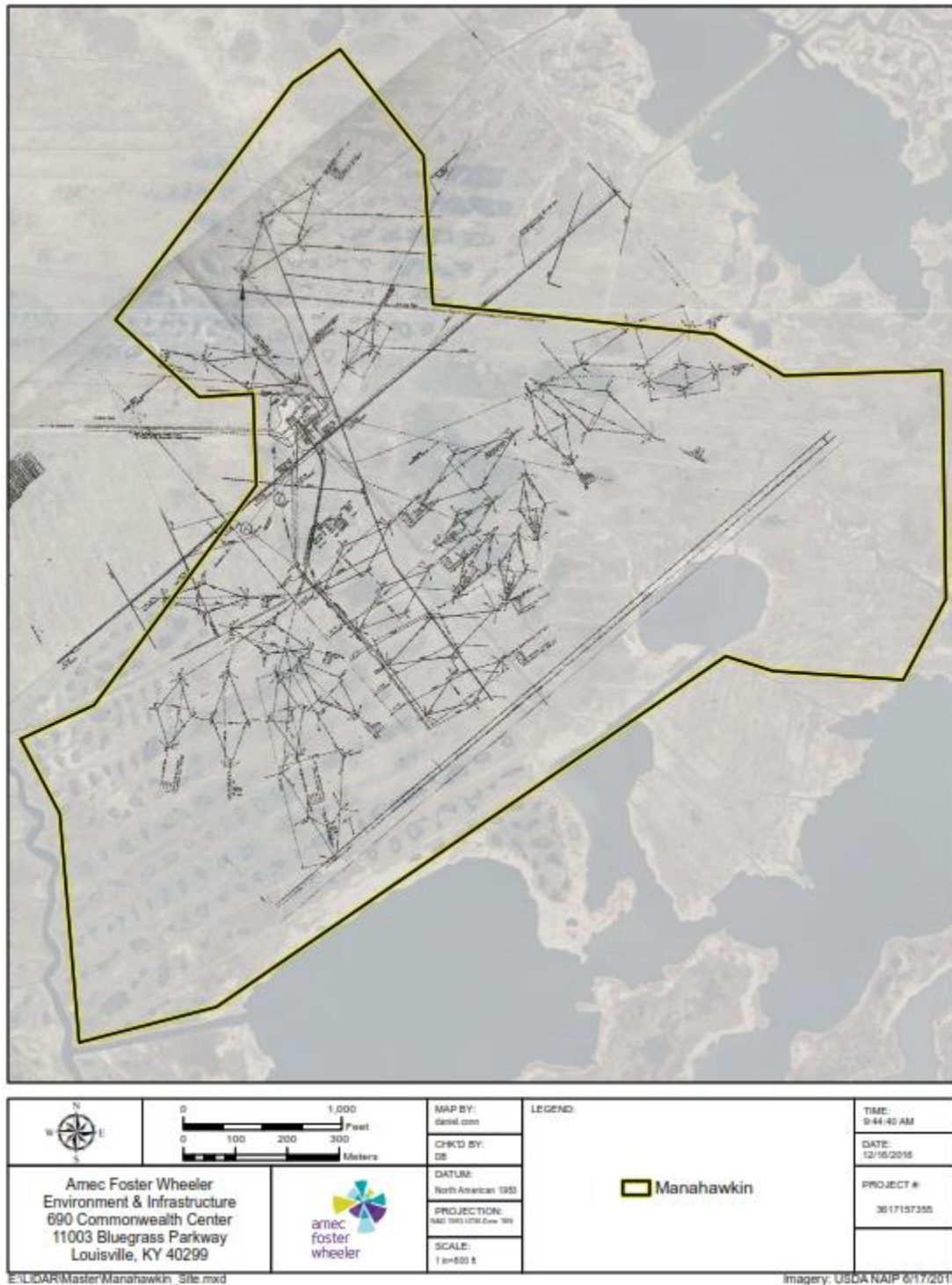


Figure 22. Site plan of the Manahawkin rhombic antenna array.

3.2 Ocean Gate Transmitting Station: New Way for Ship-to-Shore Calls

A new building to house equipment for the transmission of telephone messages to ships at sea was completed by the American Telephone and Telegraph Company at Ocean Gate, New Jersey in 1930 (Fink and Bennett 1930). Ship-to-shore telephone service for the public was first inaugurated in December 1929 with a transmission from the Bell Telephone Laboratories experimental station at Deal Beach, New Jersey to the S.S. Leviathan, an ocean liner at sea off the coast. According to press reports the Leviathan made the first broadcast from a ship at sea, the program originating from the ship's on-board nightclub, the Club Leviathan. The transmission was made from the ship to the AT&T receiving station in Forked River, New Jersey and sent from there by long distance lines to New York and on to broadcast stations. AT&T had multiple New Jersey locations including one at Lawrenceville, New Jersey. Extensive development experimentation occurred at the station at Deal Beach in connection with radio telephone service with an early call from the ship the S.S. America to a private residence as a demonstration in 1922 (**Figure 23**). When construction was completed on the transmitting station at Ocean Gate, ship-to-shore transmission became their sole focus (Fink and Bennett 1930).

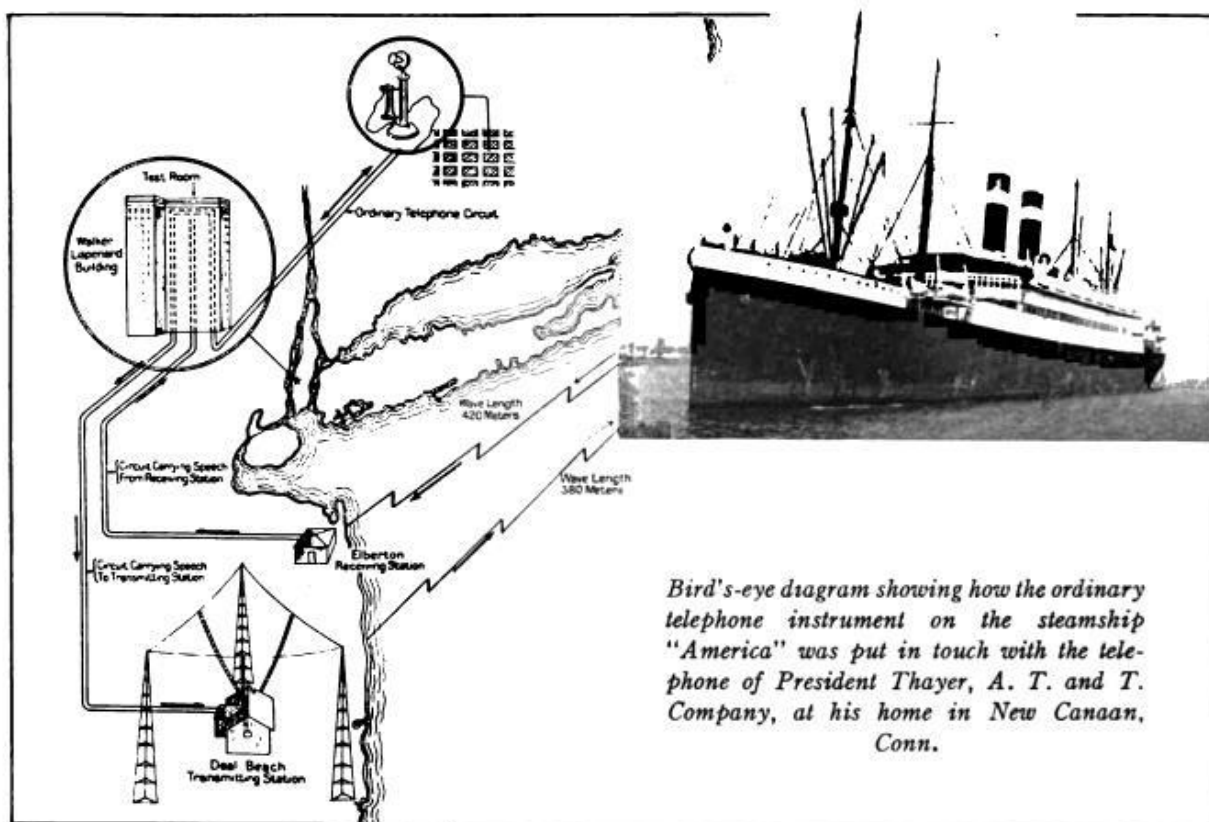


Figure 23. Diagram of ship-to-shore telephone transmission that occurred in 1922 (Long Lines, April 1922:30-31).

By 1930 the ship-to-shore radio telephone service was furnished to four ocean liners, the S.S. Leviathan of the United States Lines, the S.S. Majestic, the S.S. Olympic, and the S.S. Homeric of the White Star Line (Fink and Bennett 1930). From the S.S. Homeric off Alexandria, Egypt a passenger talked directly to someone in New York with call transmitted by the wireless telephone

equipment aboard ship and intercepted by the receiver at Forked River. The messages were switched over land lines to New York for a total distance of about 5,100 miles (*The Hopewell Herald* 1931). This distance was extended in 1931 with a call from the S.S. Belgenland off Bombay, India to New York for a distance of about 8,000 miles (*The Hopewell Herald* 1931). Sometime later three short wave radio transmitters were located at Ocean Gate, two were used for ship-to-shore service and one was assigned to the Paris circuit (Weber 1938). The pair of ship transmitters used several frequencies in the short wave band depending on weather conditions, time of day, and season of the year.

The transmitting station was located on a 175 acre tract of unobstructed salt marshes. The fact that the property was flat, unobstructed, and undeveloped made it ideal for the construction of a radio transmitter and antenna array. The installation at Ocean Gate originally had four antenna for short wave transmission. The curtain antenna array at Ocean Gate consisted of coarse-mesh curtains suspended from 70-foot poles placed in a line broadside to the direction of transmission, with two antenna suspended between a pair of 125-foot Douglas fir poles (*The Hopewell Herald* April 20, 1938). Along with the extensive antenna array, the station housed the transmitting sets and associated equipment that would link radio and wire circuits, and the auxiliary machinery necessary to operate the station. The building was built to be modernistic in design with accentuated vertical lines and room for expansion of services which did occur sometime in the 1950s (**Figures 24-27**). According to the AT&T Bulletin (Fink and Bennett 1930) one room which housed the junction point between the land lines from New York and the radio circuits was completely lined with copper preventing radio waves from the outside antenna from entering the room and affecting the operation of the transmitting apparatus. The quartz crystals for the control circuit of the transmitter was installed in a heat-insulated oven with temperature regulation and standardization. While transmissions were sent from Ocean Gate, receivers were connected to directional antennas (MUSA) at Manahawkin to receive the transmissions from ships out to sea (Weber 1938). According to Weber (1938) one transmitter radiated 400 watts of power, while another transmitter was capable of transmitting 20,000 watts of power.



Figure 24. Ocean Gate Transmitter building
(<http://long-lines.net/places-routes/OceanGateNJ/survey.html> accessed December 4, 2016).



Figure 25. Interior first floor showing some equipment at Ocean Gate transmitting station in New Jersey (website accessed December 4, 2016 <http://long-lines.net/places-routes/OceanGateNJ/index.html>).



Figure 26. Second floor, east addition equipment room interior of the Ocean Gate, New Jersey transmitting station (website accessed December 4, 2016 <http://long-lines.net/places-routes/OceanGateNJ/html>).



Figure 27. Second floor, west equipment room interior of the Ocean Gate, New Jersey transmitting station (website accessed December 4, 2016 <http://long-lines.net/places-routes/OceanGateNJ/html>).

The main call sign at the new shortwave station was WOO (Whiskey Oscar Oscar) commissioned in 1930 engaged primarily in contacting with Atlantic shipping and communicating with Europe and South America (**Figure 28**). In 1937, the FCC approved the installation of several new shortwave transmitters and five new channels were assigned for use at Ocean Gate. A small 400 watt transmitter was installed that same year for contact with nearby coastal shipping and could be heard by local fishing boats in the Atlantic under yet another call sign WOU (*Shortwave Central* 2010; *Wavescan* 2010).

Although the station was initially constructed for commercial phone purposes as early as 1933, it began to be used for relay broadcasting of programs to Europe and Latin America. By the early 1940s WOO began to be used by the Office of War Information for the relay of Voice of America programming broadcast to Europe, South America, and the South Pacific (*Shortwave Central* 2010). Voice of America broadcasts in May 1942 consisted of daily four hour service of VOA programming for Australia and the South Pacific over two outlets with channel call signs WOJ and WOK. The final known VOA broadcasts from Ocean Gate WOO were on January 1944 although the station continued to be used as an American terminal for international phone calls (*Shortwave Central* 2010; *Wavescan* 2010).



Figure 28. Radio call sign for Ocean Gate Radio (website accessed November 6, 2016 <http://www.teslaradio.org/historical.htm>).

Since its construction in 1930, the facility continued to grow by adding more acreage and newer antennas. The station was important during WWII when millions of calls were placed to passengers aboard ships at sea. Ocean Gate was one of only three AT&T telephone transmitting stations in the United States with the others in Florida and California. During WWII, the station was under armed guard and was used by the Office War Information (*Ocean County News Journal* 1976). Critical to communications with Europe, messages transmitted from Ocean Gate were instrumental in coordinating the Normandy Invasion in 1944 (*Ocean County News Journal* 1976). Although originally built as a ship-to-shore telephone service, the station would later become a point-to-point station providing telephone service to several countries including Paris, London, Moscow, Buenos Aires and Iceland. Ocean Gate provided the first point-to-point telephone service to Lima, Peru (*Ocean County News Journal* 1976). In the 1970s, the station transmitted to Guantanamo Bay, Cuba, Uruguay, Paraguay, Bolivia, Ethiopia, and Liberia with individual transmitters dedicated to communicating with Cuba, Uruguay, Paraguay, Ethiopia, and Liberia (*Ocean County News Journal* 1976). One technician remembered that Ocean Gate played a major role in rescue operations in the Caribbean when an ocean liner ran aground in 1970 when the US Coast Guard coordinated evacuation efforts through communications at Ocean Gate (*Ocean County News Journal* 1976). The station also was the communications link to the mainland when a bomb scare on the Queen Elizabeth forced evacuation of the ship on a Caribbean cruise and even provided a special telephone line to Egypt for visiting President Anwar Sadat (*Ocean County News Journal* 1976).

In the mid-1950s the large array of curtain antennas was removed and replaced with a series of rhombic antennas. By the time the station was closed in the late 1990s the station had a host of transmitters. When additional undersea cables were laid between Europe and North America and when satellite communication became available, AT&T Ocean Gate Radio was no longer needed (*Shortwave Central* 2010; *Wavescan* 2010). In 1999, the FCC authorized AT&T to discontinue high seas service from Ocean Gate as well as sister stations at Dixon, California and Pennsuco, Florida. The land containing the antenna field is now part of the Edwin B. Forsythe National Wildlife Refuge managed by the U.S. Fish and Wildlife Service. The building is owned by the local government in Berkeley Township and is now the home to the Tesla Radio Foundation and Museum.

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